REMARKS

Claims 1-28 were pending in the application. In the Office Action mailed April 16, 2009, claims 21-28 are withdrawn from consideration as directed to a non-elected invention, and claims 1-20 are rejected. In the instant Amendment, claims 1 and 13-20 have been amended, and new claims 29-30 have been added. Upon entry of the instant Amendment, claims 1-30 will be pending in the application.

Claim 1 has been amended to recite that the difference in concentrations of the uncompensated impurity and vanadium is such that the single crystal has an electrical resistivity at room temperature of at least 1 x 10^5 Ωcm. Support for this amendment is found, e.g., in the specification as filed at p. 11, ll. 15-22; and p. 12, ll. 8-14.

Claims 13 and 14 have been amended to recite a silicon carbide single crystal wafer that has an electrical resistivity at room temperature of at least 1 x 10^{10} Ωcm and 1 x 10^{11} Ωcm, respectively. Support for these amendments is found, e.g., in the specification as filed at p. 20, Table 1 and at p. 23, Table 5.

Claims 15-20 have been amended to depend directly or indirectly on claim 1.

Support for new claims 28-30 is found, e.g., in the specification as filed at p. 20, Table 1 and at p. 23, Table 5.

No new matter has been added by these amendments.

Restriction Requirement

Applicants affirm the election of Group I, claims 1-20, drawn to a silicon carbide crystal or wafer.

Rejection under 35 U.S.C. § 102(b)

Claims 1-7 and 11-16 are rejected under 35 U.S.C. § 102(b) as being anticipated by US patent publication no 2001/0023945 by Carter Jr. et al. ("US '945"). Claims 1, 4-7, 11, and 12, are rejected under 35 U.S.C. § 102(b) as being anticipated by Jenny et al., 1996, Appl. Phys. Lett. 68:1963-65 ("Jenny").

Claim 1, as amended, recites that in the claimed silicon carbide single crystal, the difference in concentrations of the uncompensated impurity and vanadium is such that the single crystal has an electrical resistivity at room temperature of at least 1 x 10^5 Ωcm. In

contrast, US '945 teaches that in its silicon carbide crystal, vanadium is either absent, or if present, is present in amounts below those which will substantially affect the resistivity of the crystal, preferably below 1E16 (see, US '945, paragraph [0034]). Further, US '945 teaches that the most preferable resistivity is merely at least 50,000 ω-cm at room temperature (see, US '945, paragraph [0036]). Therefore, US '945 does not teach a silicon carbide crystal having a difference in concentrations of the uncompensated impurity and vanadium such that it has an electrical resistivity at room temperature of at least 1×10^5 Ωcm.

Jenny discloses using Hall effect, deep level transient spectroscopy and optical absorption measurements to determine the position of vanadium acceptor level in vanadium and nitrogen doped 6H and 4H SiC (Abstract). Jenny teaches that the maximum solubility of vanadium in SiC was determined to be 3.0×10^{17} cm^{-3}, and that at such incorporation limit, the vanadium acceptor level could be used in the creation of semi-insulating silicon carbide (Abstract). Jenny does not teach a silicon carbide crystal having a difference in concentrations of the uncompensated impurity and vanadium such that it has an electrical resistivity at room temperature of at least 1×10^5 Ωcm.

Therefore, claims 1-7 and 11-16 not anticipated under 35 U.S.C. § 102(b) by US '945 or Jenny.

Rejection under 35 U.S.C. § 103(a)

Claims 1-10, 17, and 18 are rejected under 35 U.S.C. § 103(a) as being unpatentable over US '945. Claims 11, 12, 15, and 16 are rejected under 35 U.S.C. § 103(a) as being unpatentable over US '945 as applied above, in view of US publication no. 2003/0233975 to Jenny et al. ("US '975"). Claims 19 and 20 are rejected under 35 U.S.C. § 103(a) as being unpatentable over US '945 as applied above, in view of US patent No. 6,522,080 to Faillon et al. ("US '080").

As discussed above, claim 1, as amended, recites that in the claimed silicon carbide single crystal, the difference in concentrations of the uncompensated impurity and vanadium is such that the single crystal has an electrical resistivity at room temperature of at least 1×10^5 Ωcm. In contrast, US '945 teaches that in its silicon carbide crystal, vanadium is either absent, or if present, is present in amounts below those which will substantially affect the resistivity of the crystal, preferably below 1E16 (see, US '945, paragraph [0034]). In other words, US '945 teaches that the presence of vanadium in any amount that may affect the resistivity of the crystal is undesirable. US '945 teaches that the most preferable

resistivity is merely at least 50,000 ω-cm at room temperature (see, US '945, paragraph [0036]). Thus, US '945 does not teach or suggest that vanadium can be used in a silicon carbide crystal to allow achievement of an room temperature electrical resistivity of at least 1 x 10^5 Ωcm. US '945 does not teach or suggest that the amount of vanadium can be selected such that the difference in concentrations of the uncompensated impurity and the vanadium is sufficiently low to achieve the high electrical resistivity.

In the Office Action, although the Examiner acknowledges that US '945 fails to teach the specific relationship instantly claimed in instant claims 8-10, the Examiner stated that it would have been obvious to one of ordinary skill in the art at the time of the invention to adjust the amounts of nitrogen versus the amounts of vanadium in SiC for the intended application, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. However, only result-effective variables can be optimized:

> [a] particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation.

MPEP 2144.05 II B at p. 2100-152 (Rev. 6, September 2007). In the present case, US '945 did not recognize that electrical resistivity is a function of the difference in concentrations of the uncompensated impurity and vanadium. Thus, the parameter was not recognized by US '945 to be a result-effective variable. In fact, in US '945, the highest resistivity achieved is merely at least 50,000 ω-cm at room temperature, which is much lower than that achieved by the present invention, further demonstrating that US '945 does not teach or suggest the presently claimed invention.

US '975 teaches a method for producing high quality semi-insulating silicon carbide crystals in the absence of relevant amounts of deep level trapping elements. Specifically, US '975 sets forth that an object of the invention is to avoid the use of vanadium to produce semi-insulating character in silicon carbide (see, US '975 at p. 2, para. [0021]). US '080 teaches using SiC in microwave field effect transistors and does not consider vanadium or nitrogen doped SiC wafers at all.

Neither US '975 nor US '080 teaches or suggests that electrical resistivity is a function of the difference in concentrations of the uncompensated impurity and the vanadium, much less to maintain the difference in concentrations to below a desired value to achieve high resistivity. Therefore, neither of these references supplies what are missing in US '945.

Therefore, claims 1-12 and 15-20 are not obvious under 35 U.S.C. § 103(a) over US '945, US '975 ,and US '080, either alone or in combination.

It is submitted that in view of the present amendment and foregoing remarks, the application is now in condition for allowance. It is therefore respectfully requested that the application, as amended, be allowed and passed for issue.

Respectfully submitted,

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